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THE OTOCYST OF THE PINNIDÆ.

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The conclusions reached in this paper were drawn from a study of the otocyst in three species of lamellibranch belonging to the family Pinnidæ.

I became interested in the subject some time ago, when I found what appeared to be an abnormal otocyst in *Atrina rigida*.¹ In the paper referred to, it was intimated that the otocyst of this lamellibranch showed signs of degeneration. Further study of this organ in the same and related species has convinced me that the otocyst of the Pinnidæ is functionless.

The following description was written after examining something over sixty specimens by the method of serial sections.

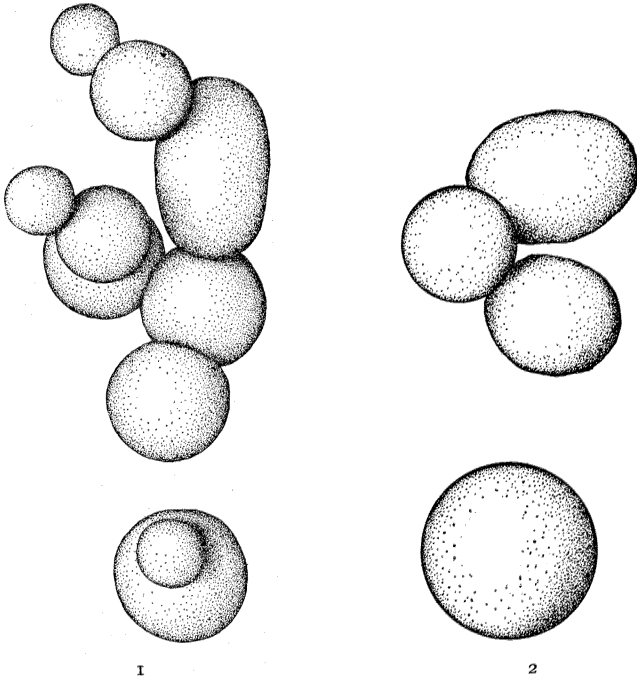
Unlike the homologous structure of other lamellibranchs, this sense organ is situated in the tip of the foot at a very considerable distance from the pedal ganglion. In general, it resembles the ordinary lamellibranch otocyst, but differs in being exceedingly large and compound. (See Figs. 1, 2 and 3.)

Instead of being a simple capsule, it ordinarily consists of several lobes, each containing an otolith. (See Fig. 3.) The lobes are quite variable in size, but as a rule they are remarkably large. One by measurement is 780 microns in diameter, while the enclosed otolith measures 520 microns. It will be noted that an object of this size can readily be seen with the unaided eye. In fact the otocyst in question stands out quite prominently.

By reference to the figures it will be noted that the larger number of the lobes of these otocysts lie in contact with each other. This together with the fact that the cavities of two adjoining lobes are frequently found to be in open communication, indicates that they were formed from an original otocyst by budding. It seems, therefore, that budding accounts for the compound nature of these otocysts.

¹ B. H. Grave, "Anatomy and Physiology of *Atrina rigida*," *Bulletin of the Bureau of Fisheries*, Vol. XXIX., 1909.

Be this as it may, the lobes are not all joined in a single mass. In fact, all of the cases figured show two isolated groups. The series of sections from which Fig. 1 was reconstructed shows that this particular otocyst was formed by two separate invaginations from the ectoderm. The tubes indicating their ectodermal nature still persist, as illustrated in Fig. 4. The same ectodermal



FIGS. 1 and 2 are reconstructions of the two otocysts of a single specimen. Note that each is composed of two separate groups of capsules. Note also that the appearance is such as to suggest its origin through a process of budding.

origin of the otocyst of another specimen, not here figured, is demonstrated by similar ectodermal tubes.

It is generally conceded that the otocysts of all mollusks are ectodermal in origin, but it is unusual for their connection with the ectoderm to remain intact in the adult. Such a connection has not, up to this time been observed except in the primitive unspecialized Protobranchia.^{1, 2}

¹ Drew, G. A., "Life History of *Nucula delphinodonta*," *Quarterly Jour. Micr. Sci.*, Vol. 44, Part 3, new series.

² Lankester, E. Ray, "A Treatise on Zoölogy," Part V., page 18.

It appears that most of the individuals of the Pinnidæ lack the otocyst altogether. There is not a trace of such an organ to be found in nine tenths of the specimens. In all, I have found only six with otocysts and in these they are highly variable in size and shape.

Of five specimens of *Pinna nobilis* from the Mediterranean, not one had an otocyst, and an equal number of specimens of the

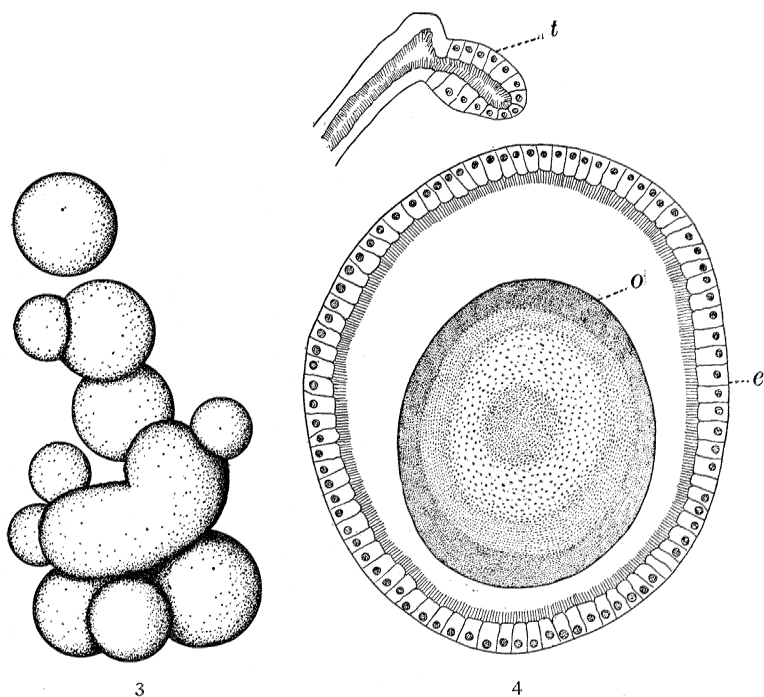


FIG. 3. Reconstruction of a particularly compound otocyst.

FIG. 4. Drawing of a section of a single capsule of an otocyst, outlined with a camera lucida. *o*, otolith; *e*, ciliated epithelium; *t*, ectodermal tube which gave rise to the otocyst.

small red *Pinna* from Jamaica¹ were examined with the same negative result.

On anatomical grounds, therefore, one is almost justified in concluding that the otocyst of the Pinnidæ is functionless.

¹ I am indebted to Professor E. A. Andrews for specimens of this Jamaican species.

PHYSIOLOGY OF THE OTOCYST.

While at Beaufort, North Carolina,¹ during the summer of 1911, the writer made a study of the function of the otocyst of *Atrina rigida*, but the experiments gave only negative results.

A considerable number of specimens were brought into the laboratory and kept under observation to learn their individual behavior. They seemed to suffer no inconvenience after the removal of the tip of the foot, which supposedly contained the otocyst. The normal activities were continued after the operation as before. The following conclusions seem justifiable:

First. A large per cent. of Pinnas have no otocyst. When one is present, it is abnormally large and curiously pathological in appearance.

Second. Anatomical and physiological evidence seem to indicate that the otocyst of the Pinnidæ is undergoing degeneration, and is at present of no functional value.

¹ I wish to acknowledge my indebtedness to Hon. George M. Bowers for the use of a table at the fisheries laboratory during my stay at Beaufort.